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NJT

PROPOSED USE OF STORAGE IN THE WANAQUE RESERVOIR WATER SUPPLY PROJECT FOR FLOOD CONTROL

Foreword

A proposal to use part of the storage of an existing water supply project to serve purposes of flood control is unusual, if not unique. The initial reaction of engineers is one of skepticism. Engineers have a tendency to remain within traditional approaches, which treat water supply and flood control as entirely different matters, each authorized, built and operated according to its own laws and institutions. However, where the good of the public is concerned, traditional approaches and paradigms are not necessarily the best. Innovative approaches may offer an improvement over old ways of doing business; and they deserve full consideration, even thoughthere is no assurance that the innovative proposal will may prove to be acceptable in the end.

Introduction

Severe damage has been caused by flooding in the Passaic River Basin for many years past, and the damages suffered appear to be increasing. The most recent major flood was in 1984; and it has been described by a U.S. Geological Survey publication.* The Corps of Engineers, U. S. Army, which is charged with flood control on a national basis, has been investigating possibilities of flood control in the Passaic River Basin for over 50 years. and a major flood control plan is currently in preliminary design stages. However, processes of designing, authorizing and building such projects are so slow and unpredictable that relief from this source cannot be expected at any early date. Accordingly, various interests and elected officials have urged that and part of the storage of the existing Wanaque water supply reservoir should be utilized to contribute to flood control for the benefit of areas frequently damaged, especially on the Wanaque and Pompton Rivers. Accordingly, in the summer of 1986, the Department of Environmental Protection (DEP) funded a study to be prepared by facility members of the New Jersey Institute of Technology (NJIT) to investigate hydrologic and hydraulic aspects of this proposal, and to determine whether the resulting reduction in flood damages would warrant the costs involved in dedicating given amounts of water supply storage to such purposes.

The NJIT Study

The NJIT Study* was a thorough one. It involved extensive evaluation of all available data, and close coordination with staff of New York District, U. S. Army, Corps of Engineers, and with staff of the DEP. While the DEP has not completely checked all computations, there appears to be no reason to doubt that the findings and conclusions of the report are substantially accurate.

The main conclusion of the report is that, while use for flood control of large amounts of Wanaque reservoir storage would not be economically feasible, such use of 5% of the storage capacity would produce flood control benefits which, upon certain assumptions, would exceed the economic costs of dedicating this amount of storage for such purposes.

The main assumptions of the report were:

1. That the North Jersey District, Water Supply Commission which owns the Wanaque project, would be persuaded or required to give up control of this portion of its storage.

2. That at such time as the water supply requirements of the region necessitate use of the water supply safe yield lost by this transaction, additional safe yield could be obtained at a cost, estimated by averaging the estimated costs per unit safe yield as given in previous studies by the DEP.

The NJIT report expressly disclaimed any intention of evaluating the legal, financial. operational or institutional aspects involved in this proposal.

Scope of Present Report

This report is intended to present a realistic analysis of the possibilities of implementing the proposal suggested by the NJIT study, of transferring the use and purpose of 5% of the storage of the Wanaque Reservoir, from water supply to flood control. According to the NJIT study, there is at least a potential for a positive finding, since it appears at least theoretically, that the benefits (to whomsoever they may accrue) may exceed the costs. The questions remaining to be considered by this study include the following.

1. What are the legal and financial requirements for obtaining control of the storage for flood control purposes?

2. What would be the operational aspects of utilizing this flood control storage in actual situations?

3. What are the policy references, and effect upon public attitudes, of adopting a flood control storage plan which can provide a major degree of control only during small floods?

4. Will this arrangement be a precedent for similar arrangements for other water supply projects?

5. What effect, if any, would adoption of such a project upon the flood control plans of the Corps of Engineers.

The proposed arrangements would involve balancing the interests of certain flood sufferers on the Wanaque Pompton and Passaic Rivers against the water supply interests of customers of the North Jersey District Water Supply Commission and its affiliated and interconnected municipal and other water companies. The Map Figure 1 shows the location of the Wanaque Reservoir, of the

flood damage areas affected, and of the area served by the water companies in question.

Legal and Financial Considerations

The Wanaque Water Supply Reservoir is a major component of the Wanaque-South Project, owned by the North Jersey District Water Supply Commission and financed by a complex set of arrangements to provide water to various municipalities, public agencies and one major investor-owned water company. Control over part of the storage of the reservoir would need to be obtained either by negotiation or by eminent domain. Legislation would be required. Funding could not be undertaken under the Water Supply Bond Act of 1981, since that Act is applicable only to water supply projects, or under the Flood Control Bond Act, which is limited to much smaller projects, on a matching basis. It could not be undertaken as a project by the U.S. Army Corps of Engineers, which after extensive studies, considered and discarded all reservoir alternatives to the recommended plan for Passaic River flood control. It could, however, be authorized by the New Jersey legislature,provided that a sufficient source of funding were included in the authorization. According to the NJIT report estimates, this would required annual expenditures of $1,650,000 for a prolonged period of time or an equivalent lump sum, required for construction of a replacement project. The source

of funding would need to be positively assured, since otherwise the bondholders of the North Jersey District loans could not be required to give up their rights.

It has been suggested that funds for this arrangement could be provided by a levy upon customers of the water companies served by the Wanaque South project. This would presumably be a tax rather than a component of the prices for water, although it could be collected with the water bill, if the legislature so specified.

It is concluded that the legislature could levy a tax upon the water companies of the region for benefit of the flood plain occupants of the region, if it so decided, although this would certainly deviate from usual concepts of taxation. Alternatively, the legislature could fund the new project through some other means.

The amount estimated to be paid for the use of the water supply storage, in the NJIT Study, was based upon the cost of water supply projects to provide an equivalent safe yield. This alternative water supply project could be built by the North Jersey District, or by the NJ Water Supply Authority, provided that funding were available. It is a difficult and time consuming process to obtain clearance to build any water supply

reservoir in New Jersey, as the decade-long struggles to build the Manasquan and Wanaque-South project amply demonstrate.

Nor is it obvious which project would be best to build. In view of the severe droughts which have affected the Passaic River Basin, and the absolutely disastrous results if a drought should ever exhaust the interconnected reservoir system, it would be necessary to initiate a study to build the new project as soon as the new arrangement was authorized. The funding provided by the tax would need to be placed in escrow for the building of the new project, in order that the municipalities and companies which have contracted for Wanaque project water could obtain water from the new project with minimum delay. As best it would probably take from six to ten years to select an alternative project, conduct an environmental impact analysis, obtain a Section 404 permit from the Corps of Engineers, and finally to design and build it. By the end of this time any temporary surplus in supply which could be obtained at the present time from the Wanaque-South project would be needed for regional growth in demand. Even if action were taken to initiate funding of the replacement project at once, there would be an interregnum during which the regional capacity to resist a severe drought would be somewhat lessened.

There would be an inherent element of uncertainty as to the financing until the actual project to be built were selected.

Therefore the funding source would need to be sufficient to cover a water supply project in its entirety. Any given project might be insufficient in size to compensate for the yield lost by dedicating 5% of storage to flood control, or might be too large, in which case a greater capital cost than estimated would need to be incurred. Obviouslv, the favorable balance of benefits to cost estimated by NJIT will only be obtained in full if the replacement project built is exactly the size to fill the need. A certain amount of conservatism would be required in the financing, in order to cover the possiblity that the project chosen as an alternative would be larger than required to meet the needs of those currently contracting for availability of Wanaque-South project water.

There are three main alternatives as to the manner in which the alternative water supply would be provided, as follows:

1. The State could commit itself to plan and build an alternative water supply, with funds appropriated for the purpose, acting through the Water Supply Authority and to make this additional supply available, at no cost, to the North Jersey District.

2. The State could pay a cash compensation to the North Jersey District, requiring the District to build a replacement water supply project to serve its

customers' needs. The amount of compensation would be determined through normal processes of eminent domain (negotiation or condemnation).

3. The State could require the North Jersey District to initiate at once the processes of planning and building a replacement water supply project, at costs to be paid by the State.

The third approach would be viable only if a special tax, special bond issue, or other dedicated funds were made available to assure that the alternative water supply would actually be provided, without expense to other customers of the Authority.

B. Operational Aspects

The flood control storage provided by this arrangement would be in the Wanaque Reservoir. The flood plain immediately downstream on the Wanaque River would be favorably affected by reduction in flows from the reservoir. See diagram Fig. 2. As shown on this diagram, two other major flood producing streams, the Ramapo and the Pequannock Rivers join with the Wanaque a few miles downstream, forming the Pompton River, on which larger flood damages occur. Of course these damages on the Pompton flood plain are less affected by flows from the Wanaque River, on

account ofthe contributions of the other two rivers. Finally, the Pompton River enters the Passaic River, where damages are still greater; but the flow regimen during floods is so complex and the total drainage area so large that the NJIT report did not attempt to assess the effect upon damages on the Passaic itself of the proposed storage in Wanaque reservoir.

During the early stages of a damaging flood, there is considerable uncertainty as to the timing and size of flood to be expected. The prediction of amount and distribution of rainfall can only be approximate, while estimates of soil moisture are also only roughly known. Therefore, as indicated on Figure 3, the operators of flood control storage would have to make their best estimates as to when to start using the available flood control storage. Outlets (gates or values) from the Wanaque reservoir can release up to about 1000 cubic feet per second. Preferably, the outlet should be used to keep the reserved flood control storage empty, as far as practicable, until the moment when filling it will have the maximum effect in reducing damages downstream. Figure 4 shows the optimum use of the available storage to reduce flood damages immediately downstream on the Wanaque River. Figure 5 shows the effect if, unfortunately, the gates are closed too early and the reservoir fills before the crest of the flood arrives. In this case, there may be no reduction in damages downstream. Figure 6 shows results if the gates are held open too long and the storage is not utilized

until shortly before the peak flow arrives. In this case, only small reduction in damages would occur. It is apparent that, in order to be of maximum benefit, operation of the flood gate will need to be handled very carefully, with support of a special network of rainfall gages, and of adequate soil moisture observations throughout the watershed, and with hydraulic engineers prepared to make rapid calculations of the movement of the flood waves.

Miscalculation become more likely when the combined effects of the three rivers are considered. As shown in Figure 7, the optimum operation of the flood storage for control on the Wanaque River could cause an actual increase in flood damages downstream, in the Pompton River flood plain, if the other tributaries peaked later. Any decision as to operation of the gates may favor the Wanaque flood plain at the expense of the Pompton flood plain, or vice versa. Even if it did not, it may be perceived as having done so. The Corps of Engineers has faced such problems in operating flood control reservoirs for many years; and it meets them in two ways.

1. District and project offices of the Corps are well staffed by hydraulic engineers and hydrologists, with close links to the U. S. Weather Bureau.

2. The Corps seldom if ever builds a flood control reservoir which cannot contain a 100 year flood. Therefore, questions as to when to start storing a flood are less difficult, as the gates can generally be closed as soon as flood damages occur at any point downstream. Even so, the Corps sometimes faces criticism as to the timing of release of a stored flood.

In order to avoid difficult decisions as to the optimum time to initiate flood control storage in Wanaque, use could be made of a predetermined "rule curve" or operating rule, such as that assumed by the NJIT study. However, unless specified by legislation, this rule curve would be the responsibility of the operating agency; and the agency would have to be prepared to defend itself against lawsuits in the even that flood damages in any locations could be shown to have been allowed by the selected mode of operation, when they might have been prevented by any other mode of action. This is no mere speculation, as shown by the fact that over 1000 lawsuits were filed against the State and the North Jersey District following the flood of 1984, despite the fact that at that time there was no physical means by which either the State or the North Jersey District Water Supply Commission could have delayed the floodwaters.

It would manifestly be to the advantage of the State if the Corps of Engineers could be persuaded to operate the Wanaque flood control storage. However, it is considered extremely unlikely that the Corps would accept such a responsibility. The North Jersey District is not staffed to handle a flood control operation, and would obviously be reluctant to assume the resulting liability. Also for any agency, staffing costs would be involved. The State DEP, if it undertook this responsibility, would find repeated exposure to numerous lawsuits a source of endless trouble and expense, particularly as, unlike the flood of 1984, it could always be shown that some groups of people could have been protected better if the gates had been operated somewhat differently. It appears that if flood control storage is to be operated in the Wanaque Reservoir, either the legislation itself should precisely and unequivocally specify the rules of operation to be used during floods, or the legislation should grant a complete protection from damage suits in the flood control operation, expect in cases of gross negligence or malfeasance.

Other Policy Aspects

This proposed arrangement with the Wanaque project cannnot be viewed as an individual matter only. If storage authorized, financed and built for water supply purposes is to be taken for

flood control purposes in this case, presumably it could be in other similar cases. Similiar proposals could well be made regarding the Boonton Reservoir of Jersey City, and the Pequannock Reservoirs of Newark, both of which control watersheds contributing to the Passaic River main damage areas. The disadvantages of such proposals are not manifestly greater than of the proposed utilization of Wanaque reservoir storage. Presumably, if the Wanaque proposal is to be adopted, similar studies should be made of the Newark and Jersey City reservoirs. A rough estimate of the cost of such studies is $200,000.

Although benefit/cost ratios are of course important, the effect upon the public of utilizing partial degrees of flood control must also be considered. As previously noted, the Corps of Engineers considers a minimum design standard to be protection against a 100 year flood. This is because in earlier years the failure of reservoir projects when breached by a major flood has caused a widespread national reaction. The infamous Johnstown flood is a case in point. In that case, the project was rebuilt with capacity to withstand and control a 100 year flood; and it failed again because of the occurrence of an even greater flood. In the case of Wanaque, the proposed dedication of 5% of the storage to flood control would reduce the peak rate of discharge in a 100 year flood only 18% on the Wanaque River and 8% on the Pompton. Even for a 25 year flood, the reduction in discharge would be only 29% on the Wanaque River and 11% on the Pompton.

Even on the Wanaque River, the project would only have a major effect in reducing damages on the smaller floods.

While the flood plain inhabitants of the Wanaque and Pompton Rivers would doubtless be very enthusiastic upon hearing of the reservation of flood control storage for their benefit, their reaction would change to resentment when they found that they continued to suffer heavy flood damages in future major floods. The policy of the State of New Jersey in providing matching funds to build flood control projects is to require that design provide to control a 100 year flood. While such a design can still be overtopped during rare events, this degree of risk is considered acceptable. If the present proposal is to be adopted, it should be prefaced by a public education campaign designed to assure that all concerned understand exactly what degree of flood protection is being provided. This aspect of limited protection is stated in the NJIT report but is not sufficiently explicit to make the point to the public, or even to the casual reader.

Consideration should also be given to the effect which adoption of this proposal might have upon the comprehensive flood control plan of the Corps of Engineers, which envisages a main flood control tunnel and associated channels and devees. It is designed to provide a high degree of protection for the main damage centers of the basin, including those on the Pompton River. Although not yet authorized, it is far advanced in the

design stage; and it is undoubtedly the only real hope that the State has of ending the tremendous threat of a repetition of the 1903 flood in the Passaic River Basin. It is the outcome of very detailed studies of costs and benefits over a period of years, which indicate its economic feasibility by Federal standards. The present proposal, by reducing flood damages on the Pompton River, and to some extent on the Passaic, would eliminate some of the flood control benefits upon which the determination of economic feasibility has been based. Such a change would require a redetermination of overall benefit cost ratio, and also of the relative advantage of extending a tunnel inlet up the Pompton River. The Corps project would probably still prove to be viable, but it would be prudent to investigate this aspect prior to committing the State to the proposed course of action.

A very important policy question is the relative importance of flood control and of drought control in the State's priorities. Certainly to those affected, the damages and inconveniences due to flood is a serious matter, despite the availability of national flood insurance. On the other hand a major drought may affect much greater areas. Figure 1 shows the area served by the interconnected water supply systems of the Northeast, which are served by the Wanaque South Project. The Wanaque-South Project is designed to assure that this area can maintain essential water supplies during a repetition of the most severe drought of the past, that of the 60's. Interconnections are a part of the

picture, assuring that as long as any reservoir has water, all will be served. However, if the system fails, it will fail as a whole. Under emergency plans, there would always be enough water for minimum personal requirements on a rationed basis; but widespread curtailment of industry would be involved, with enormous economic consequences, including serious unemployment. These are consequences which the State must not risk. If hard-worn reservoir capacity to protect North Jersey's water supply is to be taken for flood control, it must be replaced with equivalent water supply storage with a minimum interval of time, and not deferred to some indefinite future.

Conclusions

1. Flood control water supply storage in the Wanaque Reservoir should only be provided if immediate steps are taken to replace the water supply safe yield lost by the change of purpose.

2. If this is done, there may be an economic advantage to the proposed arrangement, as indicated by the NJIT study.

3. The use of the storage for flood control, as proposed, can only be obtained by legislation, providing for exercise of processes of eminent domain with just compensation, or

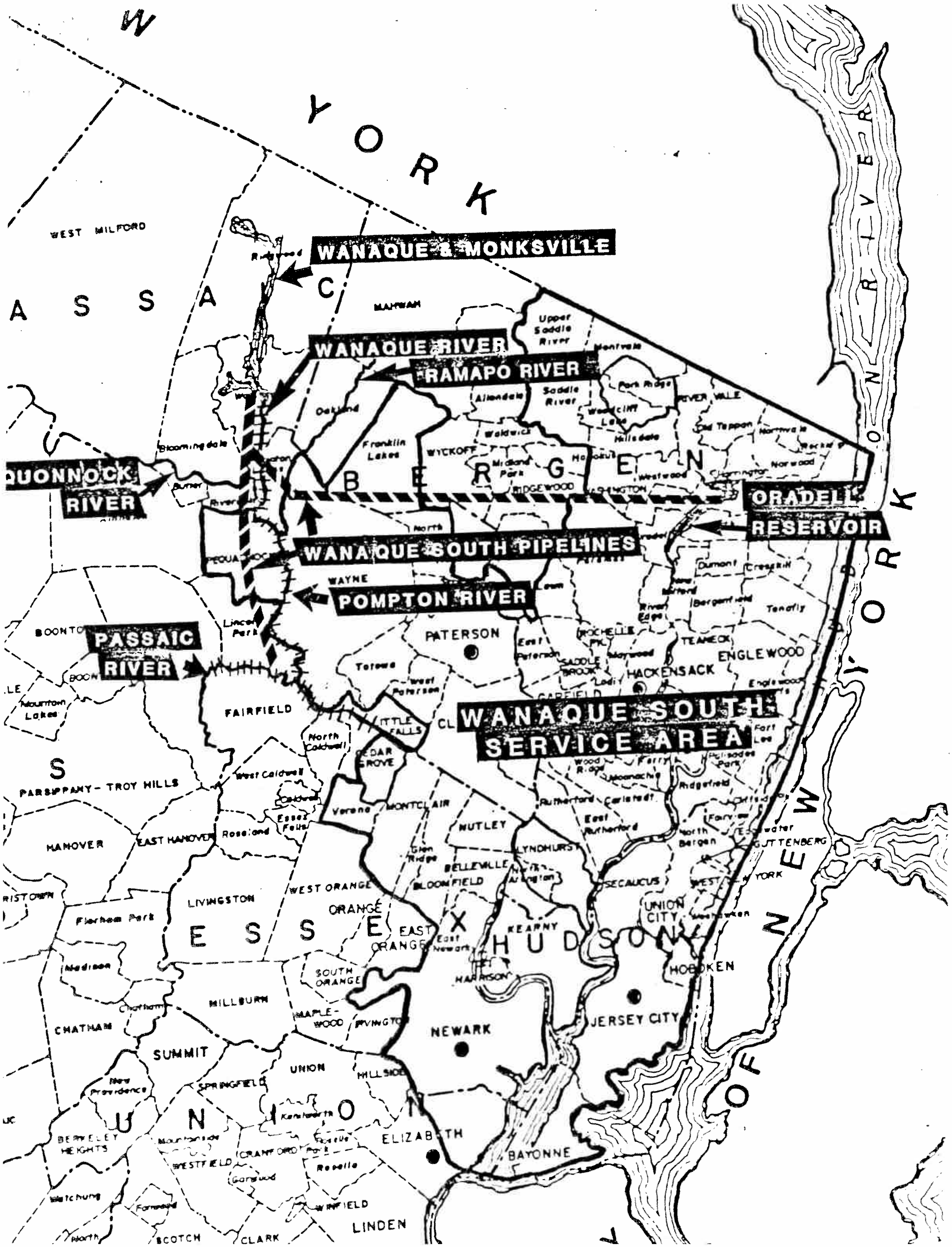
a negotiated settlement. The money, obtained presumably by a tax or bond issue, should be used for provision of a replacement water supply and for expenses of operating the flood control storage. This legislation would provide for immediate steps to initiate planning for a substitute water supply storage, either by the North Jersey District or by the State, with financing of project construction assured.

4. Preferably, the flood control storage should be operated by the Corps of Engineers, but the Corps is unlikely to accept such a responsibility. Otherwise, either the operating rules should be specified clearly and unequivacably by the legislation, or the legislation should provide immunity for lawsuits, for operation of the project, except except in cases of malfeasance or gross negligence.

5. The legislation should include an appropriation of $200,000 to investigate similar arrangements in the case of reservoirs of Newark and Jersey City in the Passaic River Basin.

6. A public education program should be provided for, to assure that all concerned understand the limited nature of the protection to be afforded, and the financing means to be employed.

7. Prior to adoption of the legislation it should be ascertained whether or not its passage would be likely to result in reducing the benefit-cost ratio of the pending Corps of Engineers proposed project, or in reducing the justification for a tunnel intake on the Pompton River.



NEW YORK
WANAQUE & MONKSVILLE
WANAQUE RIVER
RAMAPO RIVER
QUONNOCK RIVER
ORADELL RESERVOIR
WANAQUE SOUTH PIPELINES
POMPTON RIVER
PASSAIC RIVER
WANAQUE SOUTH SERVICE AREA
PASSAIC
BERGEN
ESSEX
HUDSON
UNION
HUDSON RIVER
NEW YORK
WEST MILFORD
MAHWAH
Upper Saddle River
Montvale
Park Ridge
Allendale
Saddle River
RIVER VALE
Woodcliff Lake
Oakland
Franklin Lakes
WYCKOFF
Waldwick
Hillsdale
Old Tappan
Norwood
Midland Park
RIDGEWOOD
Westwood
Bloomingdale
Butler
WAYNE
Dumont
Cresskill
Tenafly
PATERSON
TEANECK
ENGLEWOOD
East Paterson
SADDLE BROOK
HACKENSACK
Totowa
West Paterson
FAIRFIELD
Lincoln Park
North Caldwell
CEDAR GROVE
Fort Lee
PARSIPPANY - TROY HILLS
West Caldwell
Caldwell
Essex Fells
Verona
MONTCLAIR
NUTLEY
Rutherford
Carlstadt
East Rutherford
Ridgefield
Fairview
North Bergen
Edgewater
GUTTENBERG
WEST NEW YORK
HANOVER
EAST HANOVER
Roseland
Glen Ridge
BELLEVILLE
LYNDHURST
BLOOMFIELD
SECAUCUS
UNION CITY
Weehawken
LIVINGSTON
WEST ORANGE
ORANGE
EAST ORANGE
East Newark
KEARNY
HARRISON
HOBOKEN
Florham Park
Madison
SOUTH ORANGE
MILLBURN
MAPLEWOOD
IRVINGTON
NEWARK
JERSEY CITY
CHATHAM
Chatham
SUMMIT
New Providence
SPRINGFIELD
UNION
HILLSIDE
BERKELEY HEIGHTS
Mountainside
Kenilworth
Roselle Park
Roselle
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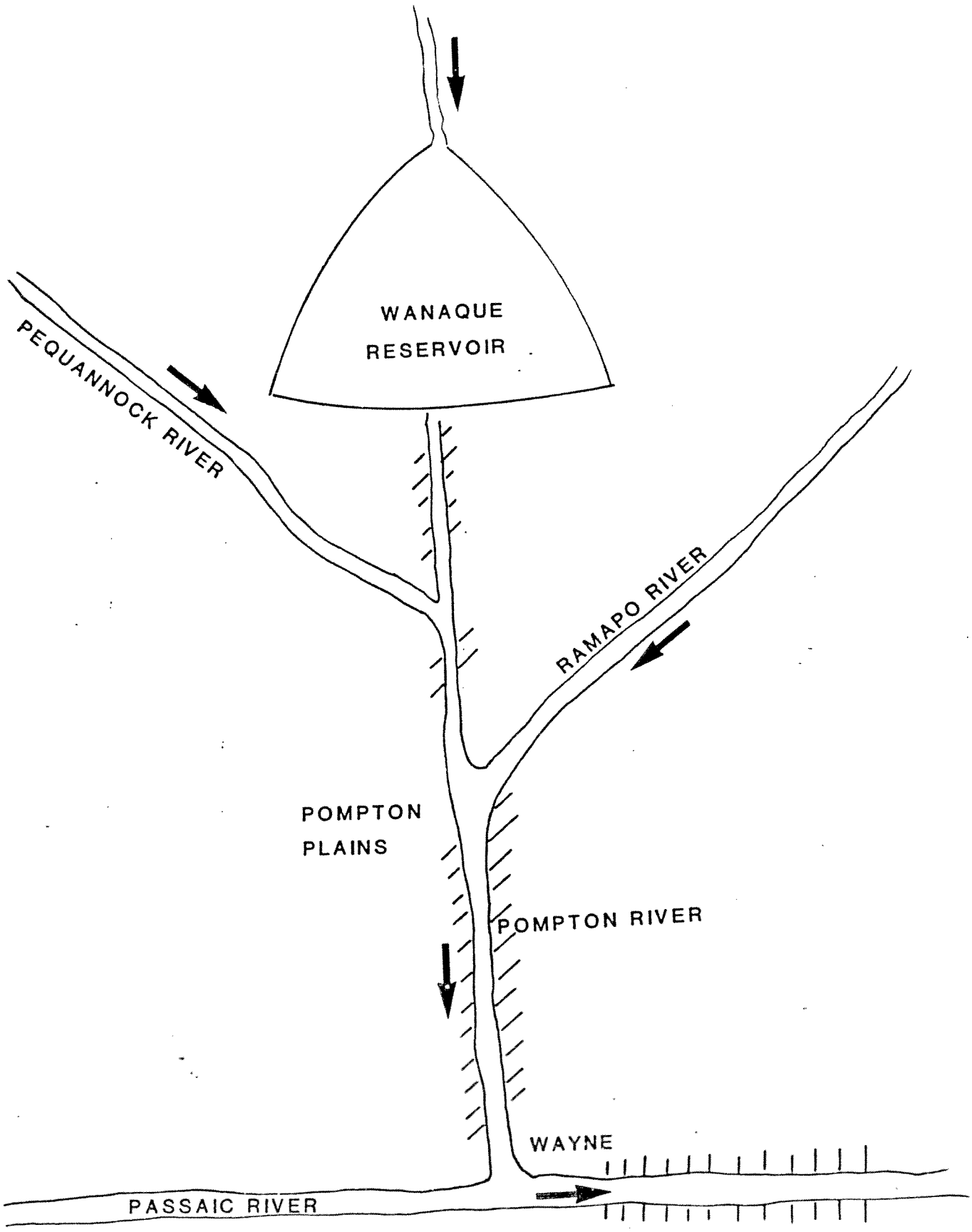
BAYONNE
WESTFIELD
CRANFORD
Garwood
Watchung
Fanwood
WINFIELD
LINDEN
SCOTCH
CLARK
Mountain Lakes


WANAQUE
RESERVOIR
PEQUANNOCK RIVER
RAMAPO RIVER
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WAYNE
PASSAIC RIVER

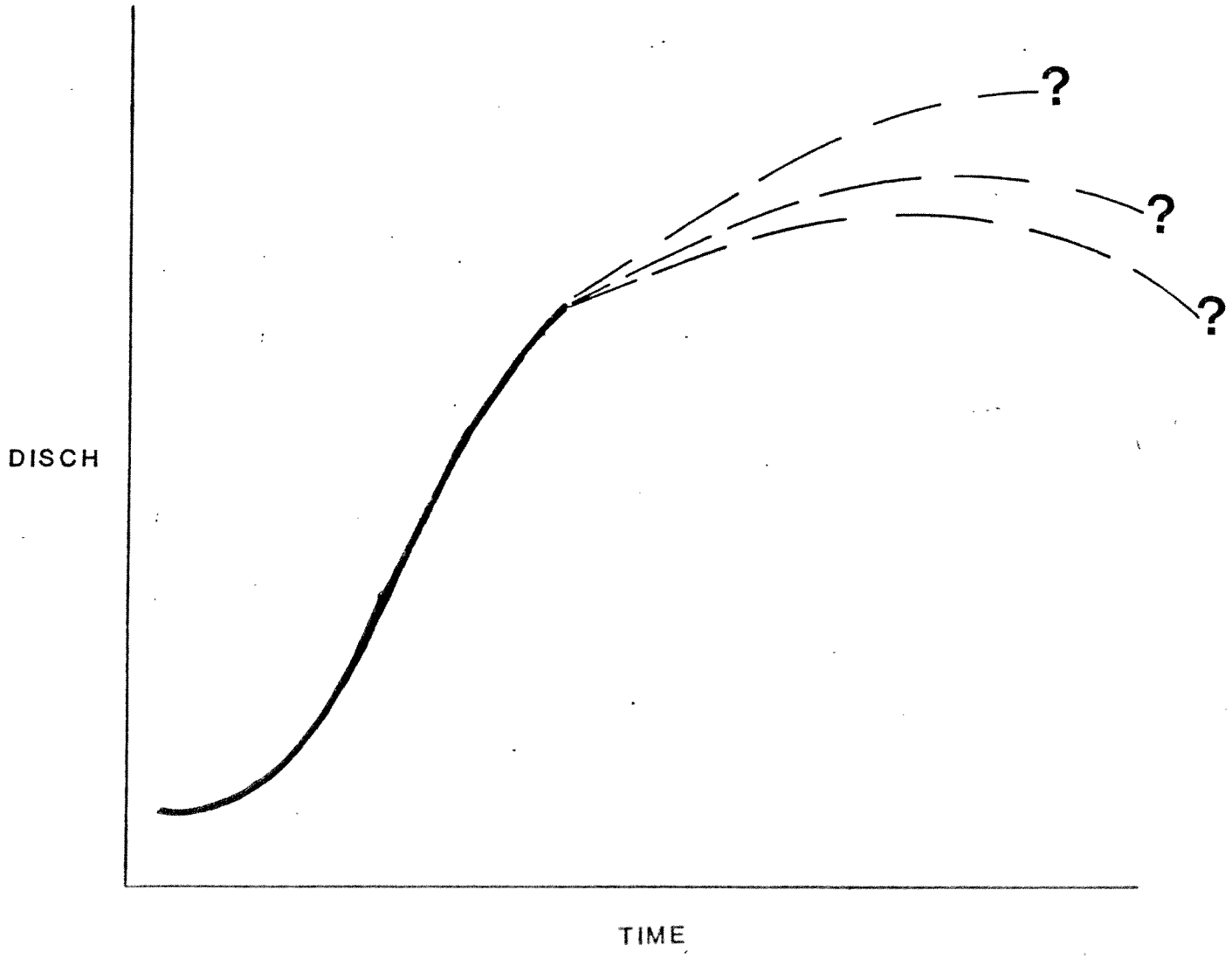
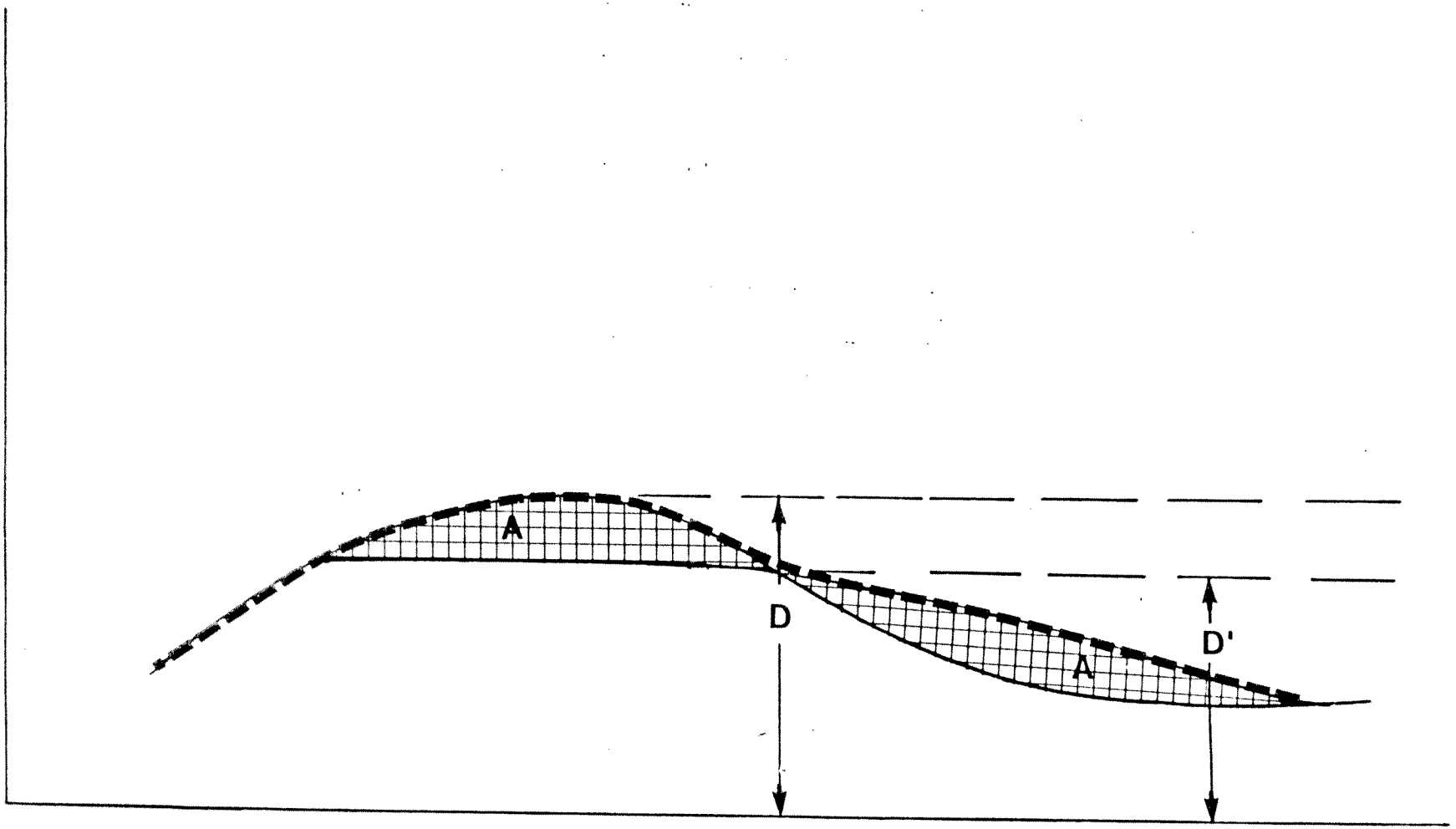
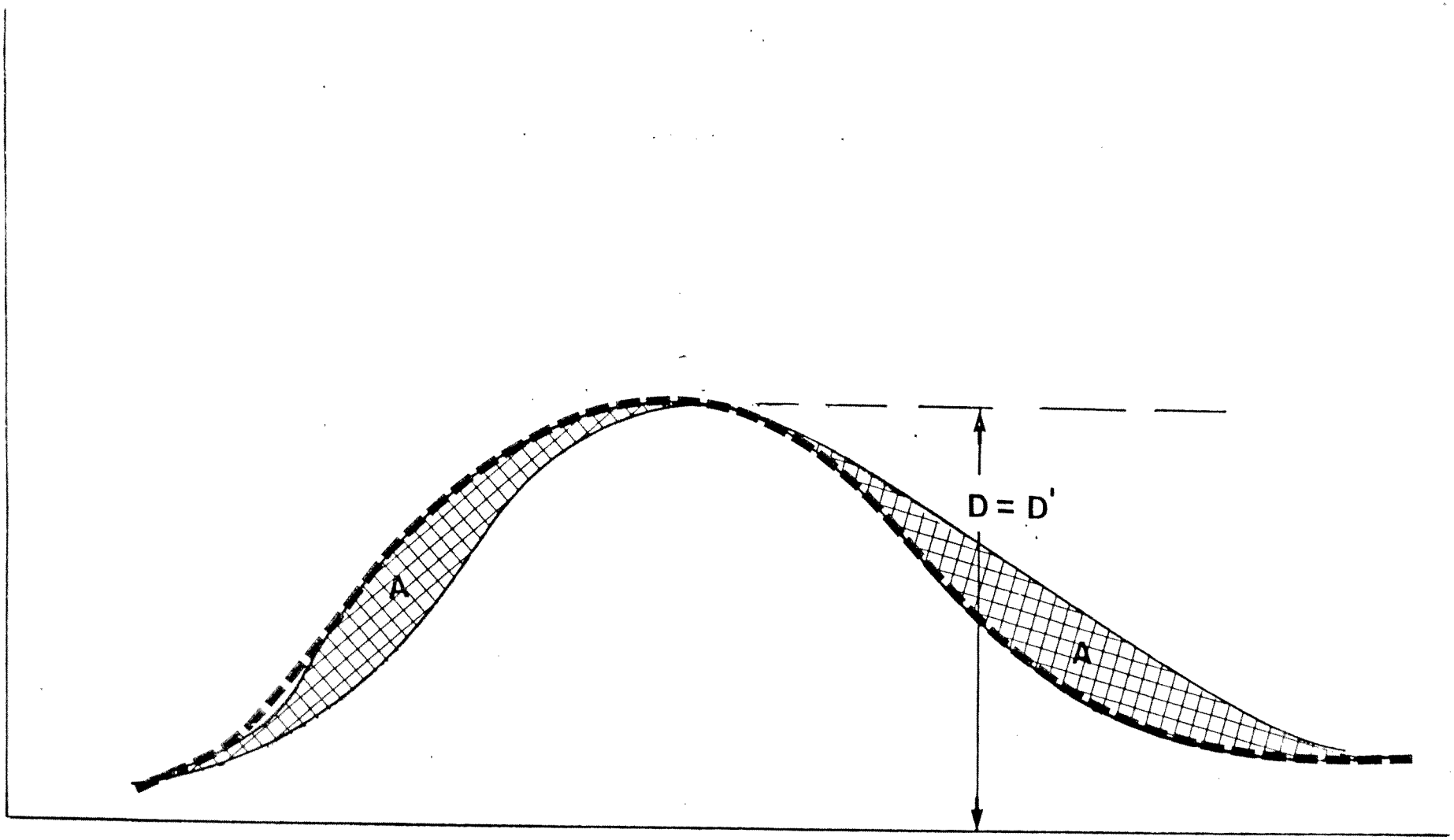


FIGURE 3



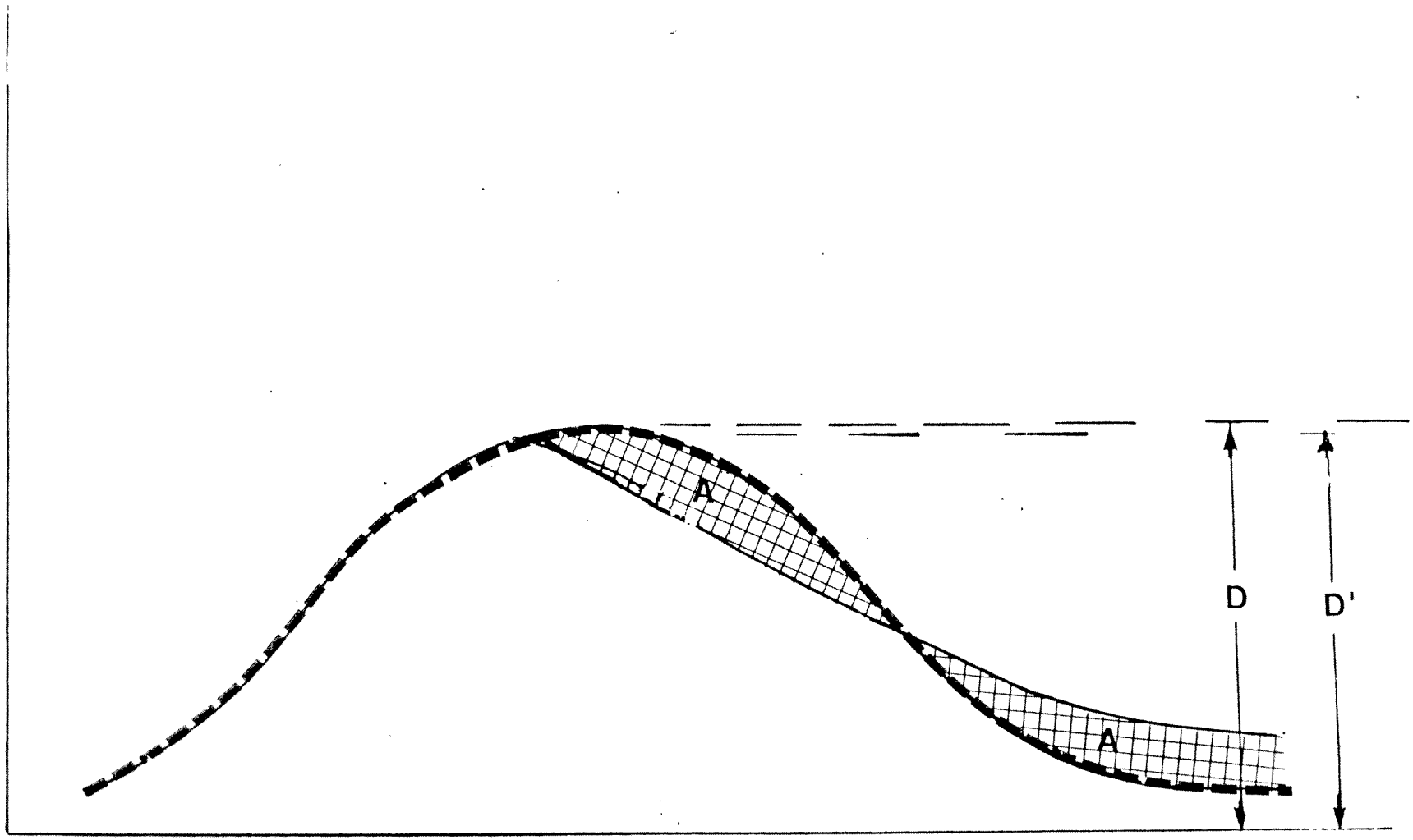
OPTIMUM OPERATION SINGLE DAMAGE AREA (WANAQUE RIVER)

FIGURE 4



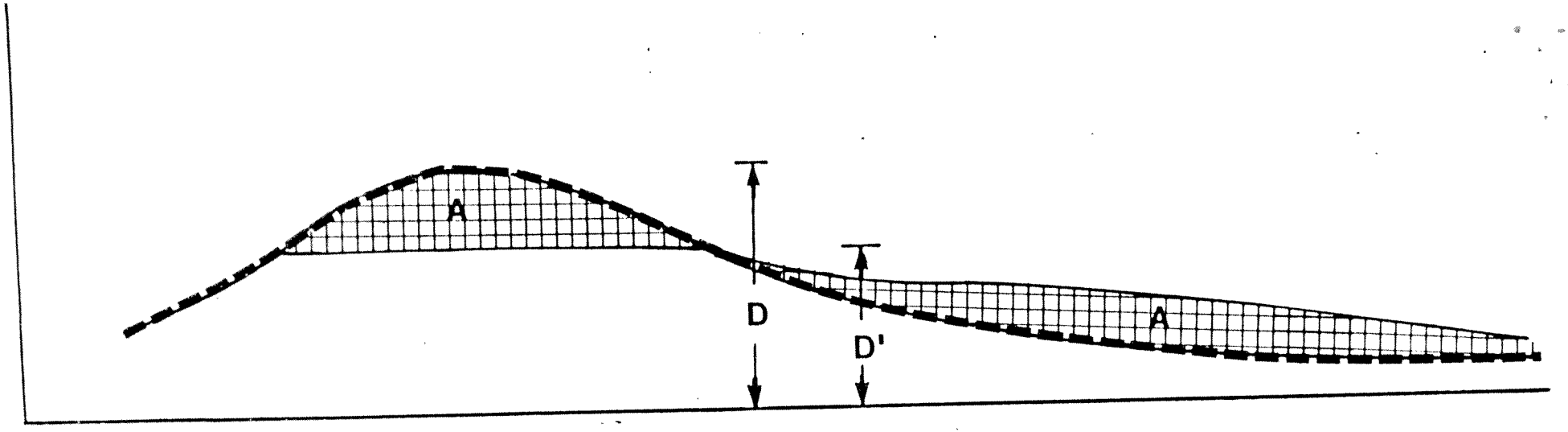
SINGLE DAMAGE AREA PREMATURE USE OF STORAGE

FIGURE 5

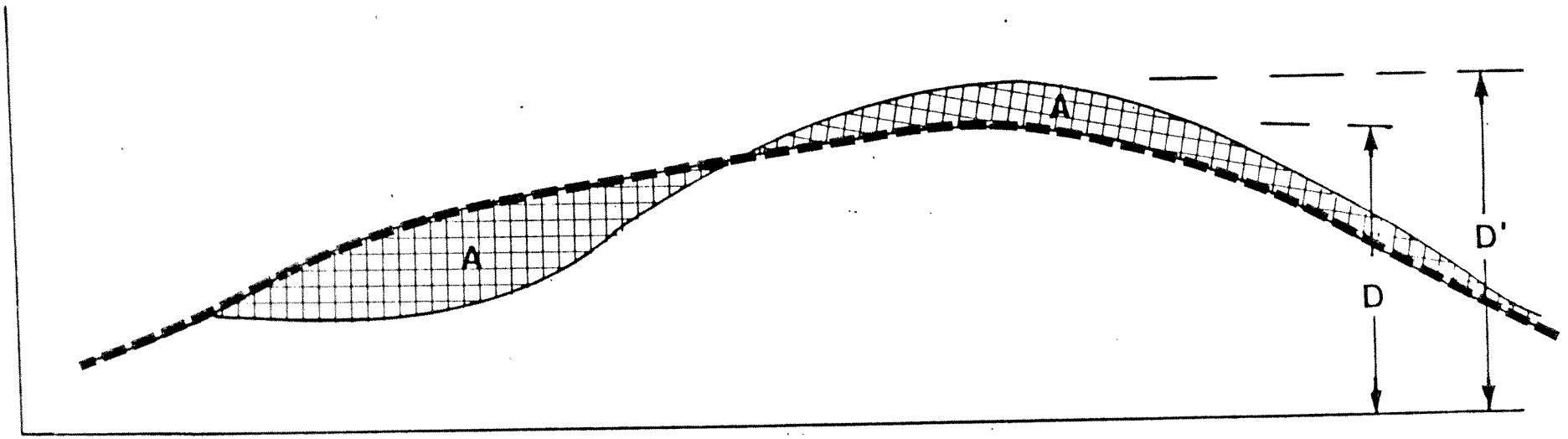


SINGLE DAMAGE AREA RETARDED USE OF STORAGE

FIGURE 6



OPTIMUM USE UPSTREAM AREA



RESULTS DOWNSTREAM IF ANOTHER TRIBUTARY PEAKS LATER

FIGURE 7